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Induction Sealing Heat Profile Improvement

FIELD OF THE INVENTION

[0001] This invention relates generally to a bottle having a cap closure with an induction heated seal. More particularly, the invention is related to a blow molded bottle or container that has an improved induction heated seal.

BACKGROUND OF THE INVENTION

[0002] Leaking between the cap and the bottle is a common problem with extrusion blow molded bottles where neck finish tolerances can vary by as much as +/- 0.3 mm. Various types of caps have been developed, especially for use by the dairy industry, where leaking bottles can be a major problem for fillers, retailers and consumers. However, none of the developments so far seem to solve the problem, which is inherent in the lightweight extrusion blow molded neck finish.

[0003] Conventionally, milk has been packaged in cardboard, gable top packs, which are notoriously difficult to open and result in numerous consumer complaints about milk spillage and difficulty in pouring. The fiber carton was only suitable for packaging liquids up to a capacity of 1.5 liters.

[0004] In order to resolve these problems blow molded plastics polyethylene bottles have been used. These bottles are provided with resealable caps. The resealable caps are normally injection-molded items. Since weight is significant in the packaging of fluids such as milk, these caps must also be light in weight. A weight of 2 to 4 g is usually the maximum that can be tolerated.

[0005] There is also a fundamental problem in achieving a good seal between a blow molded bottle neck and an injection molded plastic cap. This is because the tolerance of the neck is on the order of 0.3mm whereas the tolerance of an injection-molded item such as the cap is 0.1mm. This means that a proportion of caps will not seal tightly when fitted to their necks. For all designs of caps this results in difficulties of fitting on the production line and, for retailers and distributors, leakage problems. The ultimate consumer may also have difficulty in resealing the bottle or opening it in the first place if the cap is over-tight.

[0006] A number of designs of injection molded caps have been developed in an attempt to address these problems. For example, in a cap design known as a valve seal or pliable seal closure, a plug is provided in the cap which pushes into the neck of the bottle and

a multiple start thread is provided on the interior wall of the cap skirt. This type of cap provides a double seal. The plug provides the seal against the inner wall of the neck. The second seal is provided by means of an inwardly projecting ridge above the threads on the inner wall of the cap, which seals against the outer wall of the neck. A pliable pull away ring around the lower edge of the cap can provide tamper evidence for this type of cap. With a cap made of low density polyethylene, it is possible to prise off the cap with the ring attached so that this form of tamper evidence is not very secure.

[0007] Another design known as the induction heat seal closure (IHS) provides a foil insert seated into the base of the cap. On the production line the filled bottles with caps fitted are passed through an induction heater, which fuses the foil to the neck of the bottle. When the consumer unscrews the cap the neck of the bottle is still sealed by the foil. This foil seal is pulled off in a separate operation. Severing the seal results in small hairs of the plastics material being raised on the surface o£ the bottle neck which can inhibit a good seal being formed when the cap is replaced after initial opening. The setting of parameters for the bonding process using an induction heat seal closure is critical in order to achieve a bond which is weak enough to allow the consumer to be able to peel away the foil, yet strong enough to maintain a good primary seal with the container neck. Because the presence of the foil means that no plug can be provided, the susceptibility to leakage in the consumer's home is increased as the resealing of the cap is poor. The cap is also relatively expensive as the provision of the peelable foil insert can add as much as 20% to the cost of the container.

[0008] Spreckelsen McGeough of Little Gawton, Horsell Vale, Woking, Surrey GU21 4QU Great Britain, has taken a different approach to this old problem. The result is a bonded aluminum plastic (or BAP®, a registered trademark of Spreckelsen McGeough) closure, which comprise a cap, foil seal and bottle neck all in one, that is welded to the HDPE bottle after filling.

[0009] The BAP closure consists of a cap and a precision injection molded bottle neck with a pourer lip. The lower end of the neck is sealed with an induction welded aluminum foil which itself includes an integrated pull ring. The snap-on cap is supplied already fitted to the bottle neck. Immediately after filling the BAP closure is placed on top of the bottle and the lower surface of the foil is welded to the open bottle neck. This results in a highly effective seal between the bottle and the BAP closure, which are in effect welded to either face of the aluminum foil. When the cap is removed the consumer opens the container by simply tearing out the central area of the aluminum foil using the integrated pull-ring, and discards it. The

remaining narrow annular section of foil continues to perform its role in welding together the two parts of the bottle. The bottle can be successfully resealed using the snap-on cap only. By using an injection-molded neck finish and an injection-molded cap a high quality secondary seal is easily achievable.

[0010] Tests carried out by Spreckelsen McGeough indicate that the seal achieved is far superior to that achieved using a conventional valve cap or foil cap.

[0011] The role of the BAP closure in reducing leakage in extrusion blow molded bottles is clear, but there are other advantages. For the bottler there is a considerable saving on material, with the ability to use even lower bottle weights. The fact that the bottle neck is fitted after filling totally divorces the neck finish from the filling aperture – in other words a much larger diameter filling aperture can be designed into the bottle, regardless of the selected cap size, increasing filling speeds and enabling bottlers to increase output from existing equipment.

[0012] A disadvantage of many foil seals is the difficulty in removing them, either because they are too firmly welded to the bottle or because the pull-tab is too small to grip. The BAP pull-ring foil provides tamper evidence as well eliminating this problem. And the precision molded lip makes it easy to pour, even from a lightweight 3 or 5 liter bottle of milk.

[0013] Because PET neck finishes are injection molded they do not present the leakage problem seen in HDPE, but BAP technology also has potential applications in aseptic filling, retort sterilization filling and other areas. The cap closure with improved induction heated seal according to the present invention is particularly useful with wide-mouth, blown finishes.

SUMMARY OF THE INVENTION

[0014] Particular embodiments of the invention provide a method of bonding a neck to a plastic container. The method includes providing the container with an opening having a first bonding surface, providing the neck with an opening having a second bonding surface, providing a foil seal between the first bonding surface and the second bonding surface, induction sealing at least one of the first and second bonding surfaces to the foil seal by using a magnetic field generated by an induction sealing head, and providing a field influencing object near the foil seal to influence a portion of the magnetic field generated by the induction sealing head.

[0015] Other embodiments of the invention provide an induction sealing head for bonding a neck to a plastic container, the container having an opening at least partially surrounded by a first bonding surface, and the neck having an opening at least partially surrounded by a second bonding surface. The sealing head has a magnetic field generator for

generating a magnetic field that is to be absorbed by a foil seal placed between the first bonding surface and the second bonding surface, at least a portion of the energy created by the absorption of the magnetic field by the foil seal causing the foil seal to be bonded to at least one of the first and second bonding surfaces. The sealing head also has a field influencing object located near the foil seal to influence a portion of the magnetic field generated by the magnetic field generator. By influencing the portion of the magnetic field, the field influencing object prevents the portion of the magnetic field from heating the foil seal in a particular area of the foil seal.

[0016] Further objectives and advantages, as well as the structure and function of preferred embodiments will become apparent from a consideration of the description, drawings, and examples.

BRIEF DESCRIPTION OF THE FIGURES

[0017] The foregoing and other features and advantages of the invention will be apparent from the following, more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawings wherein like reference numbers generally indicate identical, functionally similar, and/or structurally similar elements.

[0018] Figure 1 shows a comparison of temperatures using a metal object according to the invention and not using such an object;

[0019] Figure 2 shows the average temperature of the foil for the current induction coil design;

[0020] Figure 3 shows the max temperature of the foil for the current induction coil design;

[0021] Figure 4 shows the foil when it was sealed with the regular induction sealing head;

[0022] Figure 5 shows the foil being sealed with metal placed in the center of the object; and

[0023] Figure 6 shows a digital image of the BAP closure with the foil induction sealed to it.

DETAILED DESCRIPTION OF THE INVENTION

[0024] Embodiments of the invention are discussed in detail below. In describing exemplary embodiments, specific terminology is employed for the sake of clarity. However, the invention is not intended to be limited to the specific terminology so selected. While exemplary

embodiments are discussed, it should be understood that this is done for illustration purposes only. A person skilled in the relevant art will recognize that other components and configurations can be used without parting from the spirit and scope of the invention. All references cited herein are incorporated by reference as if each had been individually incorporated.

[0025] The present invention consists of a new induction sealing head design that solves current 63+ mm BAP closure ring pull failures. These ring pull failures are due to the input of excess heat into heat sensitive bonded areas. This invention will allow the outer edge of the sealing foil to reach an appropriate sealing temperate while preventing the interior foil temperature from heating beyond ring pull bond failure.

[0026] The present invention will also have the ability to reduce the amount of heat that goes into the product but still maintain the proper amount of heat that is required for generating a proper seal. By reducing the amount of heat going into the product, the customer has less of a chance for obtain a burned smelling or tasting product.

[0027] The old method consists of a coil which will generate a magnetic field when a large voltage is supplied to the coil. This magnetic field is then absorbed into the aluminum foil which causes it to heat up. Since the foil has a layer of plastic on the foil, the plastic also heats.

[0028] The disadvantages of this system is that the operator must have the system set to a level that provides an adequate seal but does not exceed that temperature or the foil will burn and cause the product to smell/taste burnt. Although this balance has been obtained in the current industry it has not been obtained for the BAP closure systems. The BAP closure has an aluminum foil with a layer of plastic on each side of the foil. When the foil is heated it melts the plastic and will become bonded to the interfacing parts (cap and bottle). The problem that arises is that when a cap has a lower melting point then the bottle (the plastic on the foils have two different melting points), the lower melting point will be reached and will loose its bond strength while attempting to bond the higher melting point temperature.

[0029] The present invention places a metal object, which can be cooled fluidly, inside the induction coil head. This object, which can, for example, be a tube or machined cooling line, will absorb the induction field currents (since it is metal) in areas that the foil should not heat up and then the heat would be removed from the metal object by the cooling system. The advantage is that this invention may prevent the failure of the BAP closures when being sealed onto a PET package. It will also remove the heat going into the product which will prevent consumers from obtaining burnt smelling or tasting products.

[0030] The present invention takes an induction coil head (possibly a round coil configuration) and implements it, for example, in either of the following configurations: 1) a copper tube, or machined metal piece, will be placed in the induction head in the interior of the induction coil and the cooling lines will exit through the top of the coil; or 2) a metallic plate with the corresponding cooling lines will be mounted to the base of the induction coil.

[0031] Figures 2 and 3 show temperature profiles of different power settings and the duration of time that the corresponding power setting was applied according to the present invention. These two graphs show the average temperature of the foil and also the max temperature of the foil for the current induction coil design.

[0032] Figure 1 shows the average and maximum temperature for a regular induction sealing head (without a metal insert) over various power settings. This graph also shows the average and maximum temperatures that were obtained for an induction sealing head with a metal insert for a time of 4 sec at a power setting of 6. The difference in the graph shows that a metal insert reduces the average temperature while maintaining (or increasing) the maximum temperature.

[0033] By placing a metallic object or any material that will absorb the induction field, we can control the temperature in the center of the foil. Other areas of the foil can also be controlled but the example discussed focuses on the center of the foil because, for one, this is where the pull ring exists. The maximum temperature for the presently preferred embodiment (polypropylene closure to a PET package) must be at the outer edge of the foil, which is where the PET package makes contact. The present invention is focused currently on the PET material since it has a higher melting point temperature (approximately 550°F) than the polypropylene (approximately 260°F).

[0034] Figures 4 and 5 show the temperature profile of the foil when it achieves the maximum point in the sealing process. Figure 4 shows the foil when it is sealed with the regular induction sealing head. Figure 5 shows the foil being sealed with metal placed near the center of the foil. As one can readily appreciate from the maximum and minimum temperatures on Figures 4 and 5, the present invention can lower the temperature where the metal resides.

[0035] Figure 6 shows a digital image of the BAP closure with the foil induction sealed to it.

[0036] The embodiments illustrated and discussed in the specification are intended only to teach those skilled in the art the best way known to the inventors to make and use the invention. Nothing in this specification should be considered as limiting the scope of the present

invention. All examples presented are representative and non-limiting. The above-described embodiments of the invention may be modified or varied, without departing from the invention, as appreciated by those skilled in the art in light of the above teachings. It is therefore to be understood that, within the scope of the claims and their equivalents, the invention may be practiced otherwise than as specifically described.